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EXPERIMENTAL INVESTIGATION OF STITCHED AND UNSTITCHED BAMBOO FIBER USING SUGARCANE POWDER

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ABSTRACT

To examine the performance analysis of stitching and unstitching of a bamboo fiber laminate and to investigate the de-lamination resistance of laminates. Unstitched, and stitched specimens were prepared with orientation, and tensile, compression and impact tests were conducted. From the experiment strength, deformation and breaking forces were found. From the obtained results it is found that the breaking strength of a stitched bamboo is greater than the unstitched specimen also de-lamination gets reduced due to stitching.

KEYWORDS: Bamboo Fiber Cloth, Sugar cane Powder, GFRP & Epoxy Laminates

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Original Article

INTRODUCTION

An extensive literature survey has been carried out and the salient observations are grouped under two major areas as impact force, impact damage area of stitched and unstitched composites.[1]On in plan mechanical properties of fiber – reinforced polymer composites are studied over fifty reviews into the effect of thickness.[2]In-plane

It demonstrates prediction of stitching which influences on the in-plane properties, it's governed by a variety of factors and type of composite, the stitching conditions, and loading conditions. The indications of these findings for the use of stitching in lightweight structures are discussed. [3] The aim of evaluating the efficiency of stitching by reinforcing mechanism to improve the delaminating resistance of laminates which, examined by impact response of stitched graphite.[4] The low- level impact was carried on stitched carbon fiber-reinforced plastic which laminates of thickness, that behavior studied over force -displacement curve, penetration, first failure load and damage extent. The results obtained were compared with similar data available for 2D laminates. The material behavior in terms of above properties which in presents of stitches don't affect. A further impact of damage resistance was highly composited in thickness. The uses of stitch would be hinder delaminating in thin 2D laminates.

The intensity of impact and material behavior does not depend upon the damage extent. But the shape and dimension of the bodies in the impact region and wave propagation. The elastic indentation on velocity impacts at a low level. To investigate the mechanical characterization of bamboo fiber epoxy composite laminate and sugar cane reinforced with stitched and unstitched. To achieve this laminate plate will be prepared and then make specimen as per the ASTM standards. This specimen will undergo testing with a universal testing machine. To investigate the Load Vs Displacement and Stress Vs Strain with both stitched and un-stitched laminate [5]. By stitching process we are improving the strength in GFRP material along with bamboo fiber and sugar cane powder and delamination gets

reduced in it and also stiffness is increased. And also we are going to compare the results for both stitched and unstitched laminate [6].

SELECTION OF MATERIALS

Bamboo fiber are natural fiber composites, which are low cost fiber with specific properties, low density, and eco-friendly. From the figure1 we are using both gfrp and bamboo fiber for better improvement in glass fiber materials. Glass fiber reinforced plastic material of unidirectional matt is selected because these are strong lightweight material and it's bulk strength and weight are also better than many metals**.** [7] The uses of bamboo fiber and additive in biopolymer for construction. The bamboo fabrics for clothing which extracted through mechanical needling and scraping and placed under pressure in the steam explosion process. An atmosphere where exposed to detonation due to steam release for the collection of bamboo fiber.[8]The material is extremely fine and powdered state of bamboo fiber material.

As a natural substance derived from plant cellulose, bamboo fiber is decomposed in soil by microorganisms and sunlight. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers. Atest was carried out with the help of UTM (Universal Testing Machine).

The Tensile load applied to a composite.

Hydraulic testing machines are based on either a single or dual-acting piston that moves the crosshead up or down. The static hydraulic testing machines have a single acting piston or ram. The operator adjusts the orifice of a pressure-compensated needle valve to control the rate of loading. In a closed-loop hydraulic servo system, the needle valve is replaced by an electrically operated servo valve for precise control

An electromechanical machine are consists of variable-speed electric motor; a gear reduction system; and one, two, or four screws that move the crosshead up or down

The tensile load applied to a composite. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers, since these are far higher than the resin system on its own.

Having reached the end of its useful life, clothing made from bamboo can be composted and disposed of in an organic and environmentally friendly manner. [9]Synthetic fiber such as nylon, polyester and rayon are not biodegradable and remain in landfill for longer.

To develop the bio-composites with improved performance for global applications. The bagasse waste can be used to prepare fiber reinforced polymer composites

This study examines the effect of stitching on the impact performance of a class of graphite/epoxy cross-ply laminates with the aim of investigating the ability of through- thickness reinforcement to improve the delamination resistance of laminates. Unstitched, and stitched rectangular specimens (65 mm • 87.5 mm) were simply supported by a steel plate having a rectangular opening 45 mm • 67.5 mm in size and impacted at the center with energies ranging between 1 and 13 tensile, compressive, flexure, inter laminar shear, creeps and fatigue properties, although little work has been undertaken on the last three properties. When comparing studies it is apparent that many contradictions exist: some studies reveal that stitching does not affect or may improve slightly the in-plane properties while others find that the properties are degraded.

Bamboo fabrics are advertised as antibacterial, which does not retain all bamboo's original property. In research, antibacterial agents are being added to the bamboo fabric to increase its antibacterial properties. An epoxy is polymer materials are based on mechanically powerful, chemical resistants in highly adhesive from liquid to solid.

From the figure 2. The type of epoxy resins and hardener and also sugar cane powder are used for the better preparation of specimens.

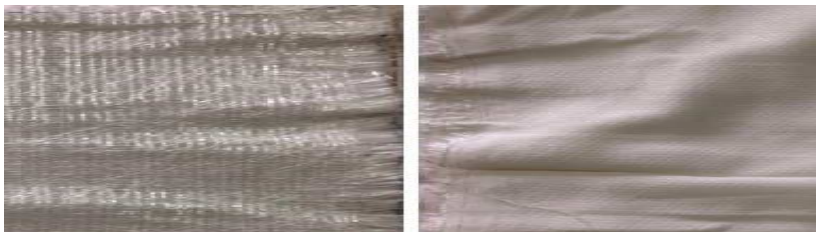

Figure 1: GFRP with Bamboo Fiber

Figure 2: EPOXY EL2 and HARDENER AT30

EPOXY EL2 is selected, and Hardener of AT30 is selected in a 100:10 ml ratio[11]. In separate containers, resin and hardener are supplied. If they combined in exactly right quantities with relative ratios, but by stirring in order the individual molecules are brought into contact with each other and then the reaction initiated to proceed the 'cure'. The chemical links up with too much of either component which affects the material and mixes remaining softer, it will easily be identified by a user. A com Sugarcane powder is extracted from sugar cane grass, which is renewable and natural agricultural resource because it provides sugar, myriad of products/co-products with ecological sustainability.

To a solid high-performance plastic material which cures the epoxies of conversation of liquid resin and hardener components. From the figure 4, epoxy and hardener are mixed in current proportion for their user. Once the components are measured in the correct ratio to each other of the initiated cure and mix well together. The cure of all epoxies is an exothermic process where heat is liberated as a natural consequence of the chemical reaction. Using epoxies efficiently is dependent upon handling the product in the correct way by avoiding wastage and premature cure, and the basic chemistry and the various stages of chemical transformation can be achieved.

If the hardener and the resin will become thick to measure and mix due to the storage temperature is too cold. The viscosity of resin 'syrup' is too thick to use and warmed until the motor oil consistency become thin. [12]Resin and hardener temperature is above 15°C, but 18-25°C is considered as ideal. The containers are stored at room temperature or warming the content to use by safe heater. The professional user who has limited heating facilities can construct a heated cabinet as an economical method. In fact, for every 10°C rise in temperature, the reaction rate will double. In order that epoxies can be fitted into a wide spectrum of uses and temperature requirements, most epoxies usually have two or more hardeners giving different reaction speeds. The user should acquaint him with the expected working characteristics given

by each system before commencing the work. The relevant information is included in the product data sheet. Ideally, no epoxy should be left to cure at a temperature of below or lower than 12-15°C

PROCEDURE FOR LAMINATE PREPARATION

From the below figure 4 we should take the gfrp unidirectional matt and should cut in a size of 300X300 mm for both the unstitched and stitched specimen. In this we should take 4 layers of gfrp for unstitched specimen and for stitched 3 layers is essential. Bamboo fiber cloth of 300X300 mm and gfrp of 300X300 mm is to take. In this we have to take 3 layers of bamboo fiber cloth and gfrp of 4 layers. On every gfrp material we have to place bamboo fiber. In this alternately we have to place these to materials.

Figure 3: GFRP Unidirectional Matt for Unstitched Laminate

Figure 4: Bamboo Fibre Cloth for Stitched Laminated is Placed on the Gfrp Material

From the below figure 2.11, we have to apply the epoxy for stitched laminate with a mixture of 5% of sugar cane powder in it. And at last add a load of 10 kg on it and place at a room temperature of about 18-20 hrs. And after that take it out. The epoxy and hardener are mixed in the ratio of 100:10 ml for both stitched and unstitched specimens. And also for stitched laminate we have to add sugar cane powder up to 5% in epoxy resin mixture for better improvement in strength.

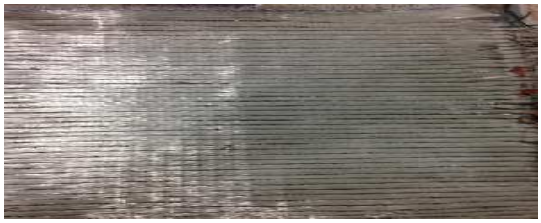

Figure 5: Stitched Laminate of Thickness 7mm

From the below figure 5, stitching is done of a thickness of 7mm, and this stitching is mainly carried out by the cotton yarn thread in parallel direction. From the below figure 2.10, we have apply to epoxy for 1st layer of gfrp and after that 2nd layer and after that sequentially remaining layers have to be placed and apply. And at last add some 10 kg of load on it and keep it at room temperature of about 18-20 hrs.

TESTING ANALYSIS

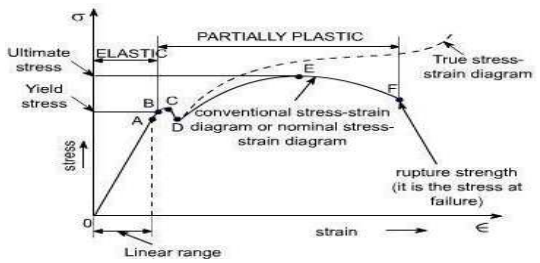

Figure 6: Stress Strain Curve

The static type of load is increased slowly from zero to a certain value and the standard specimen is used for tension test. The two types of standard specimen arel$_g$ = gauge length of the specimen on which determine the mechanical properties and The uniaxial tension test which is carried out on a tensile testing machine.

A test was carried out with the help of UTM (Universal Testing Machine)

The one of the most common testing machines is universal tester which tests materials in tension, compression or bending. The primary function is used to create the stress-strain. Testing machine can be either electromechanical or hydraulic. The method of different principal which applied the load. The specimen of motion load is in tension or compression. If the speed of the motor changed and then the crosshead speed also gets changed. In Microprocessor, the closed-loop servo system can control the accurate speed of the crosshead.

Figure 7: Stitched Laminate

Figure 8: Final Stitched Laminate

From the figure 7, 8 we are preparing the specimen according to ASTM standards for tensile test and compression test as 250mmX25mm and for charpy impact test as 10mmX80mm

RESULTS

The Glass fiber laminate is prepared using epoxy. The dimensions of glass fiber used is 300*300 mm, the laminate is made about 5mm thick, which almost uses eight sheets of glass fiber. The resin used is epoxy EL2 an adhesive hardener AT 30. They are mixed into the resin to hardener ratio of 10:1. The mixture is continuously stirred until the entire preparation is completed. The specimens are made as per ASTM standards and undergone for testing.

Tensile Testing

The composite of tensile loads is dependent upon the response on the tensile stiffness and of reinforcement fibers. Atest was carried out with the help of UTM (Universal Testing Machine). The Tensile load applied to a composite. The Tensile load applied to a composite. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers. Atest was carried out with the help of UTM (Universal Testing Machine). The testing was done at Microlab, Ambattur. And the results are as follows

Table: 1: Tensile Test of GFRP-UNSTITCHEDS1

Specimen Number	GFRP-UNSTITCHED S1
Size	26.44*5.24
Area	138.55
Type	FLAT
UTL	52.790
UTS	381

Table 2: Tensile Test of GFRP-UNSTITCHEDS2

Specimen Number	GFRP-UNSTITCHED S2
Size	22.26*5.12
Area	113.86
Type	FLAT
UTL	59.445
UTS	522

Compressive Testing

When a beam having an arbitrary cross section is subjected to a transverse load the beam will bend. A three -point bending is used to determine the compressive strength of the specimen

Table 3: Tensile Test of GFRP-UNSTITCHEDS1

Specimen Number	GFRP-UNSTITCHED S1
Size	23.38*5.26
Area	122.98
Type	FLAT
UTL	1.780
UTS	14

Table 4: Tensile Test of GFRP-UNSTITCHEDS2

Specimen Number	GFRP-UNSTITCHED S2
Size	22.21*5.25
Area	116.60
Type	FLAT
UTL	2.10
UTS	18

GFRP & BAMBOO FIBER STITCHED LAMINATE

The GFRP& bamboo fiber laminate is prepared using glass fiber, epoxy, and sugar cane fiber. The dimensions used are 300*300 mm, the laminate is made about 3mm thick which almost uses four sheets of glass fiber and 3 sheets of bamboo fiber which is about 2mm thick. The resin used is epoxy EL2 an adhesive hardener AT30 and sugarcane powder. They are mixed in the resin to hardener ratio of 10:1 with the 5% of sugarcane powder in it. The mixture is continuously stirred until the entire preparation is completed. The specimens are made as per ASTM standards and undergone for testing

TENSILE TEST

The Tensile load applied to a composite. The composite of tensile loads is dependent upon the response on the tensile stiffness and of reinforcement fibers. A test was carried out with the help of UTM(Universal Testing Machine).

Table 5: Tensile Test of GFRP-STITCHEDS1

Specimen Number	GFRP-STITCHED S1
Size	23.20*4.70
Area	109.04
Type	FLAT
UTL	40.47
UTS	371

COMPRESSION TEST

When the beam of cross section is subjected to bending in a transverse load beam. A three point bending is used to determine the compressive strength of the specimen

Table 6: Compressive Test of GFRP-STITCHEDS1

Specimen Number	GFRP-STITCHED S1
Size	23.80*4.70
Area	111.86
Type	FLAT
UTL	2.610
UTS	23

Table 7: Compressive Test of GFRP-STITCHEDS2

Specimen Number	GFRP-STITCHED S1
Size	23.80*4.70
Area	103.71
Type	FLAT
UTL	2.520
UTS	24

LOAD VS DISPLACEMENT GRAPHS

From the graphs we can compare and prove how much the load has been involved in Tensile and compression tests

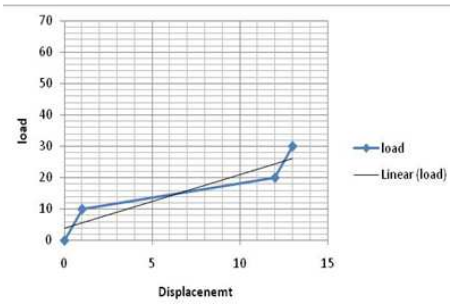

Figure 9: Load vs Displacement Curve for Unstitched Specimen 1

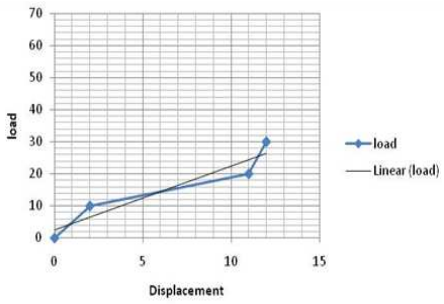

Figure 10: Load vs Displacement Curve for Stitched Specimen 1

Stress vs Strain Graphs

From the graphs we can compare and prove how much the load has been involved in Tensile and compression tests

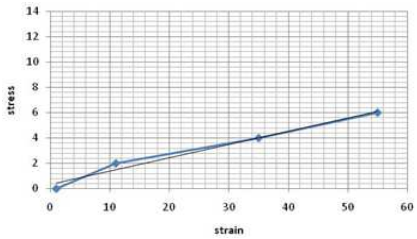

Figure 13: Stress vs Strain Curve for Unstitched Specimen1

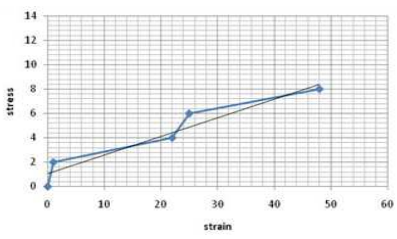

Figure 14: Stress vs Strain Curve for Stitched Specimen1

IMPACT TEST

Static tension tests of the unnotched specimen's do not always reveal the susceptibility of the composite to brittle

fracture. The specimen is placed on its supports on anvil so that blow of the striker is opposite to the notch the impact strength is defined as the energy A, required to rupture the specimen. From the above results, compression and impact tests for stitched specimen has more strength and stiffness than the unstitched specimen. Tensile test failures because of de-lamination occur in it and also low strength developed in it.

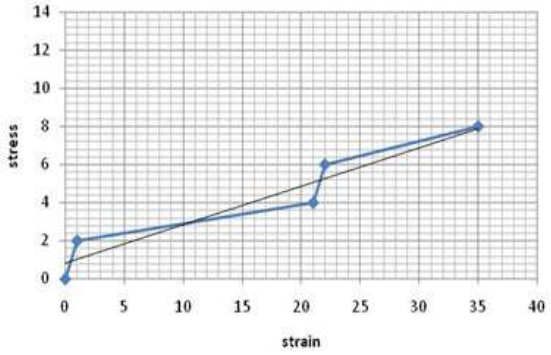

Figure 15: Stress vs Strain Curve for Unstitched Specimen2

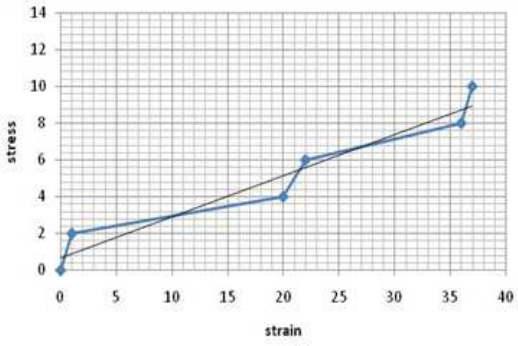

Figure16: Stress vs Strain Curve for Stitched Specimen2

CONCLUSIONS

Glass/epoxy and bamboo fiber along with sugar cane powder laminates are used for better improving the strength in fiber. A cotton, polyster thread was used to stitch prepare layers in the fiber direction with stitch density of 6 stitches/cm2. The specimens were tested at different Test as discussed above. The Strength and breaking Loads and displacement was evaluated by using backlighting technique. The following conclusions were drawn on the impact response of the unstitched and stitched laminates.

For the above impact, force evaluates by drawing a graph Load vs Deformation of both stitched and unstitched laminates. From the graph, the peak force of unstitched laminate is more than the stitched laminates in a tensile test. But for the compression and impact tests, we improve the strength in stitched laminates of bamboo fiber. Stitching of the laminate will further improve the resistance, Also from the above -obtained results, we may conclude stitched laminate is more strengthening than the un-stitched laminates.

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